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(71) Applicant: Stafford-Miller Ltd.  
Welwyn Garden City Hertfordshire AL7 3SP (GB)(72) Inventor: Scratcher, Carl  
Brecon, Powys, Wales (GB)(74) Representative: Ablewhite, Alan James  
MARKS & CLERK,  
57/60 Lincoln's Inn Fields  
London WC2A 3LS (GB)

## (54) Toothbrush

(57) A toothbrush (2) having a head (3) and a handle, the head having spaced tufts (4) of filaments (6) arranged in transverse rows, which is characterised in that the tufts (4) in each row between the two end tufts are substantially all generally quadrilateral in cross-section with one pair of sides substantially parallel to the row

and are spaced close to adjacent tufts so as to form a blade-like array of filaments across the brush head. The invention also relates to a toothbrush as described above in which the filaments (6) in each tuft (4) are generally rectangular in cross-section with one pair of sides generally parallel to the row.

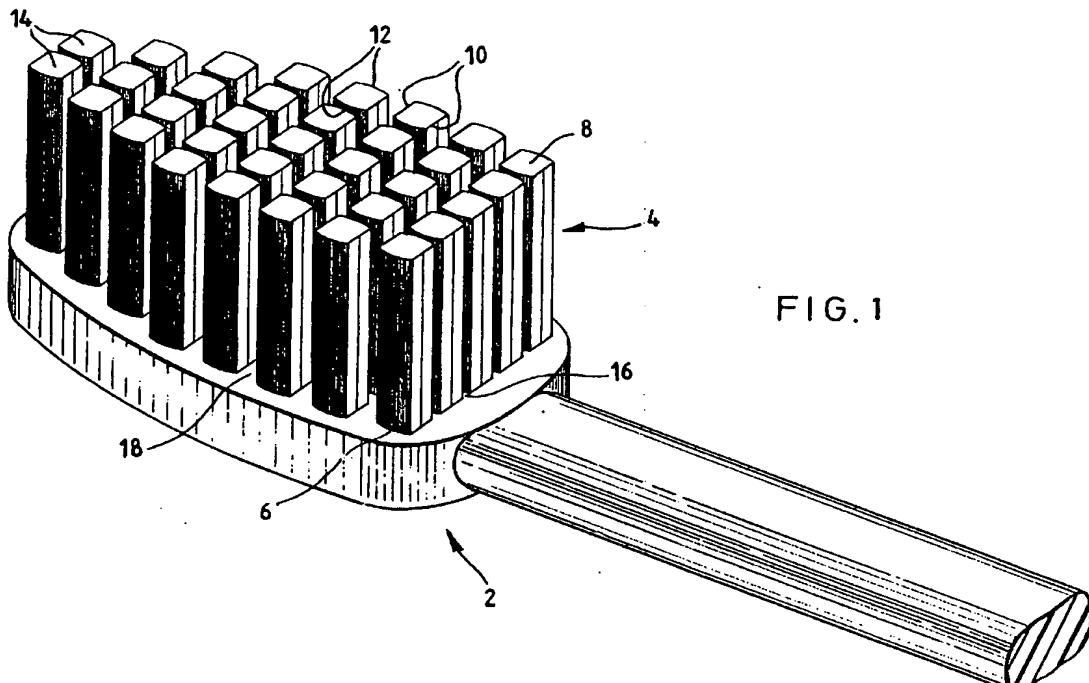


FIG. 1

EP 0 894 454 A1

**Description**

[0001] The present invention relates to a toothbrush which provides enhanced plaque removal while reducing gum damage.

[0002] The use of a toothbrush for cleaning teeth and gums to remove food and plaque is well known. A toothbrush typically comprises a head portion, from which extend tufts of filaments or bristles, and a handle. Over many years toothbrush design has been varied with respect to the nature and arrangement of the filaments on the toothbrush head.

[0003] With respect to the nature of the filaments, for example, US-A-2317485 discloses a toothbrush with shaped filaments, such as rectangular filaments, which are claimed to remove plaque more effectively than round filaments. Different filament shapes are also disclosed in EP-A-0663162.

[0004] With respect to tuft shape, EP 0449655 discloses a toothbrush with tufts having round and rectangular cross sections. PCT publication WO 94/09677 discloses rectangular tufts of filaments. Both publications also consider tuft and filament arrangement. WO 94/09677, for example, discloses a toothbrush having at least two general directional orientations of filaments, with one group of filaments oriented transverse to the axis of the toothbrush handle, and one group of filaments parallel to the axis of the handle. The two groups of filaments may be spatially separated on the brush head. EP 0449655 discloses a toothbrush with rows of filaments which differ in height, and in which the filaments are positioned at an angle from the vertical.

[0005] Despite such variants, there is still a need for a toothbrush with improved plaque removal capability.

[0006] We have, surprisingly, found that a toothbrush in which the tufts are spaced together to form blades of filaments is particularly effective in plaque removal. A toothbrush configured in this way also has an additional advantage in that toothpaste is easily cleared from the head of the brush.

[0007] Thus, in a first aspect, the present invention provides a toothbrush having a head and a handle, the head being provided with spaced tufts of filaments arranged in transverse rows, characterised in that the tufts in each row between the two end tufts are substantially all generally quadrilateral in cross-section with one pair of sides substantially parallel to the row and are spaced close to adjacent tufts so as to form a blade-like array of filaments across the brush head.

[0008] The term 'toothbrush', as used herein, is used to describe any toothbrush which is suitable for cleaning the teeth and gums. The present invention relates to a toothbrush in which the head of the brush may be integral with the handle. However, it will be appreciated that the head and the handle of the toothbrush may be separable, such that the head may be removed and replaced when worn out.

[0009] The term 'tuft', as used herein, refers to a group

of filaments. It is a feature of the present invention that the tufts are arranged in rows, and that the tufts are generally quadrilateral with one pair of sides substantially parallel to the row. We prefer that the other pair of sides of each tuft cross-section are substantially perpendicular to the row, forming a square or rectangular tuft: We particularly prefer that said other pair of sides are slightly convex, providing a cask shape to the cross-section.

[0010] It is an essential feature of the present invention that the tufts of filaments are spaced close enough together as to form 'blades' of filaments. The term 'blade', as applied herein to groups of filaments, refers to an effectively continuous line of filaments. Such lines of filaments have advantageous cleaning properties.

[0011] In order to form a blade of filaments, tufts must be closely spaced. The tuft shape is important in this respect. For example, manufacturing constraints dictate that the minimum distance between square or rectangular tufts is approximately 0.4 mm, when using a moulded plastics material to form the toothbrush. This separation is suitable for the formation of blades of filaments. However, cask-shaped tufts are especially preferred for the present invention as they allow the minimum distance between tufts to be reduced further, even to a distance of 0.3 mm, 0.25 mm, or even less. This reduction in separation is possible because the central curved rib between cask-shaped tufts is stronger than a straight rib. Furthermore, the curved nature of the inter-tuft space allows a plastics material to flow more easily around the tuft during the moulding of the head.

[0012] It will be appreciated that the minimum separation between tufts may also be determined by the material from which the toothbrush is made and the process by which the toothbrush is made. The materials and processes may be any suitable materials and processes, which will be readily apparent to the person skilled in the art.

[0013] The end tufts in each row may also be square, rectangular, cask shaped or any other suitable generally quadrilateral shape. We prefer that the end tufts are cask shaped. However, it will be appreciated that the end tufts in each row do not necessarily have to possess the same preferred geometry as the other tufts. One side of an end tuft will necessarily be adjacent to the edge of the toothbrush, and the shape of this side of the tuft will not affect the alignment of tufts to form filament blades.

[0014] The filaments may be affixed into the tufts by

any suitable means, which will be readily apparent to the person skilled in the art. However, we prefer that filaments are affixed into the tuft by staples which all run parallel to the axis of the handle. The use of staples in this way reduces tuft splay and also allows a tuft to be placed very close to a neighbouring tuft. The use of staples in combination with rectangular filaments also helps in aligning the filaments in a preferred direction.

[0015] Filaments themselves may be made of any suitable material and may be of any shape, which material and shape will be readily apparent to the person skilled in the art. However, we prefer that the filaments in each tuft are generally rectangular in cross-section with one pair of sides generally parallel to the row. We particularly prefer that the cross-section of the filaments is such that the sides parallel to the row are shorter than those perpendicular to the row. Such filaments have a greater cleaning surface area when compared to a round filament. The edges of a rectangular filament provide a further abrasive advantage over round filaments. When a filament is bent in a direction that is not directly parallel or perpendicular to the row, then the filament will twist. The combined effect of the filament edges and the twisting spring like action of the filament can significantly improve plaque removal. Furthermore, the packing of rectangular filaments is superior to that of round filaments, as no space needs to be left between filaments. This reduces the space in which unwanted food debris can accumulate.

[0016] Rectangular filaments can be packed such that there are no gaps between filaments, in contrast with circular filaments. Therefore, the use of rectangular filaments allows a high filament density to be obtained. The term 'filament density', as used herein, refers to the number of filaments per unit area, and a high filament density allows more effective cleaning of teeth. The filament density within a given blade of filaments can also be increased by the use of cask-shaped tufts, which allow tufts to be closer together than is possible with square tufts, for example. It will be appreciated that while round tufts may also be arranged close to one another, filaments cannot be arranged within round tufts without gaps between them. Therefore, the combination of cask shaped tufts with rectangular filaments provides an optimum filament density within the blade of filaments. We particularly prefer that blades of filaments have rectangular filaments in cask shaped tufts, although it will be appreciated that any packing arrangement which allows blades of filaments to be formed is suitable for the toothbrush of the present invention.

[0017] Many known toothbrushes have only a single tuft at the end of the toothbrush head that is distal from the handle. The filaments of this single tuft are prone to splay and wear during use. The present invention envisages that the close packing of cask-shaped tufts may allow two, or more, tufts to be present at the end of the brush, which provides a small blade with high filament density. This not only improves cleaning of the teeth, but

is hard wearing and may reduce the splay of the filaments. It will be appreciated that the number and arrangement of tufts is dependent upon the shape of the head. The head shape is preferably narrow enough to

- 5 allow good oral penetration, but not too narrow that the end of the brush is fragile or has a dangerous point.
- [0018] A tuft of rectangular filaments has different properties when brushed in different directions. We particularly prefer that the cross section of filaments in the tuft is such that the sides of the filaments parallel to the row are shorter than those perpendicular to the row, and that the rows are arranged perpendicular with respect to the longitudinal axis of the handle. In this configuration, the brush will be firmer when brushing across the teeth than when brushing down upon the gums. Thus, the toothbrush can be said to have a 'medium' stiffness with respect to a 'back and forth' type motion, but be classified as 'soft' with respect to an 'up and down' motion. The terms 'soft' and 'medium' are well known in the art and form part of the International Organisation for Standardisations (ISO) classification on toothbrush stiffness. The dual soft and medium properties help reduce gum damage, as the motion results in a soft action on the gums, while allowing a medium or firm action on the teeth.

- [0019] It will be appreciated that filament end shape may also be varied. We prefer that the rectangular filaments have a rounded end, which reduces abrasion of tooth enamel, dentine and gums. We also prefer that the filaments are all of approximately equal height, such that the all filaments are flexed when in contact with the teeth when the brush is in use.

- [0020] Embodiments of the present invention will now be described by way of example only, with reference to the accompanying drawings, wherein:

Figure 1 is a perspective view of a toothbrush according to the present invention and,

- 40 Figure 2 is a plan view of a toothbrush head according to the present invention.

- [0021] Figure 1 shows, in perspective view, a toothbrush 2 according to the present invention. The toothbrush 2 contains tufts 4 of filaments 6 which are arranged in transverse rows to form blades. The tufts 4 are generally cask shaped 8, with one pair of sides 10 parallel to the row and the other pair of sides 12 convex, providing a cask shape to the cross section of the tuft 4.

- 45 The filaments 6 are all of equal height, such that all the filaments 6 are flexed when the brush 2 is in use.

- [0022] The spacing 16 between the tufts 4 may be as little as 0.25 mm. The spacing 18 between the rows is such that the blades can flex and bend to sweep plaque away from the teeth. This gap helps to prevent the build up of residual toothpaste on the head, and allows the toothpaste to be easily cleaned to remove toothpaste from the head.

[0023] The end of the toothbrush 2 distal to the handle is shown with two cask shaped tufts 14. These two tufts allow for improved cleaning with respect to brushes that contain only one tuft.

[0024] Figure 1 shows a toothbrush with handle attached, in part. It will be appreciated that the handle may be of any design or material, and the features of the handle are not essential for the purposes of the present invention.

[0025] Figure 2 shows a plan view of a toothbrush head 3 according to the present invention. The plan view shows the rows of tufts 4 and the cask-shaped nature of the tufts 4. The narrow spacing 16 between the tufts 4 is clearly indicated, which allows the formation of blades of filaments.

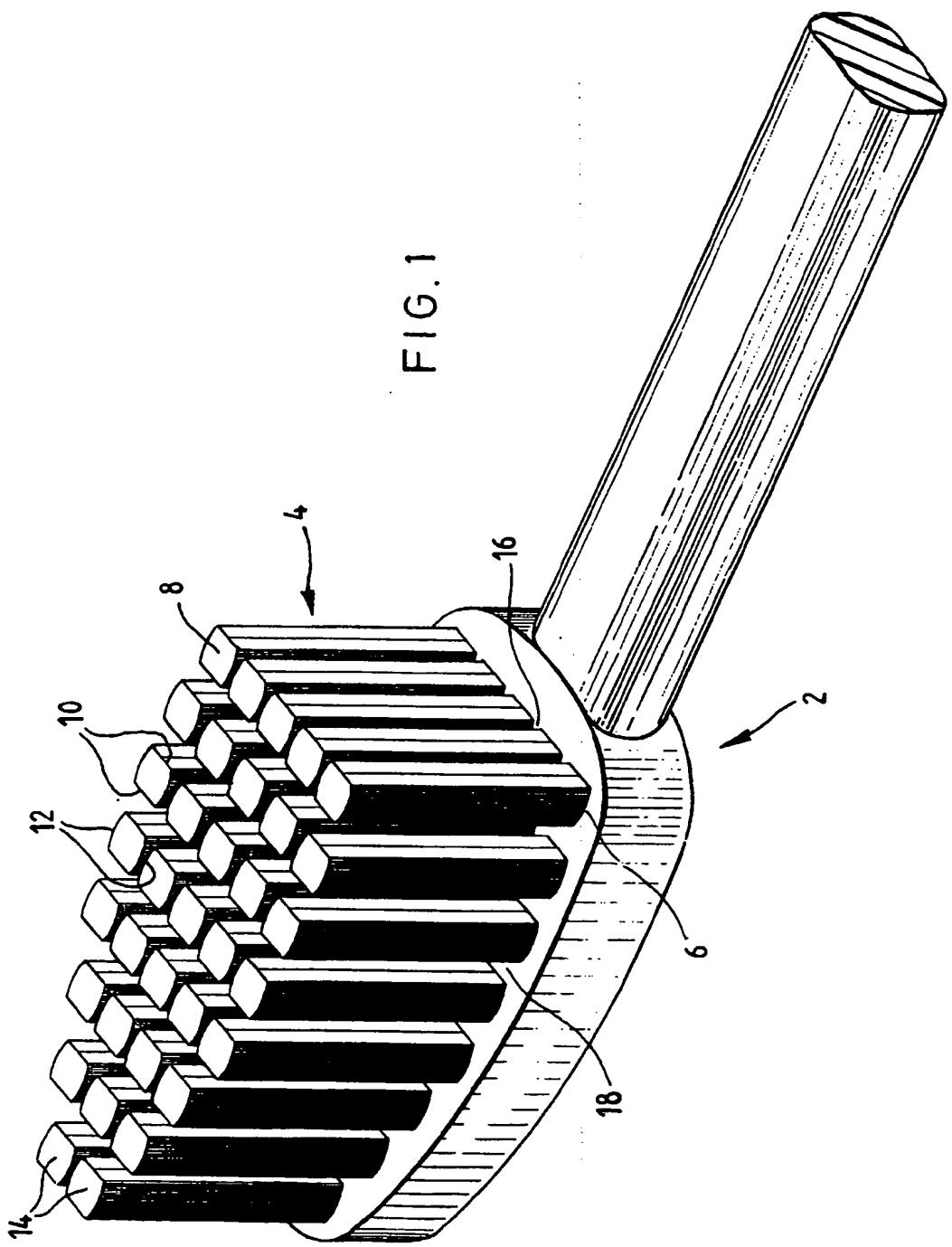
[0026] In this embodiment the end tufts in each row are shown as being cask-shaped, although it will be appreciated that the end tufts do not necessarily have to possess the same preferred geometry as the other tufts.

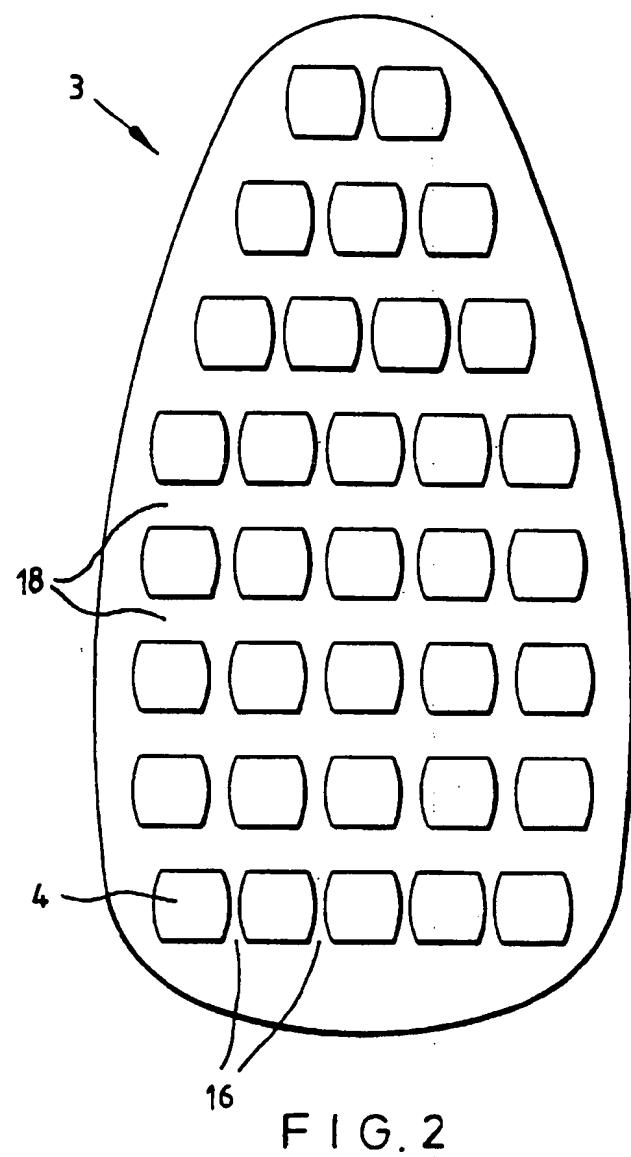
8. A toothbrush according to any preceding claim wherein the filaments are affixed into the tuft by staples which are parallel to the axis of the handle.

### Claims

1. A toothbrush having a head and a handle, the head being provided with spaced tufts of filaments arranged in transverse rows, characterised in that the tufts in each row between the two end tufts are substantially all generally quadrilateral in cross-section with one pair of sides substantially parallel to the row and are spaced close to adjacent tufts so as to form a blade-like array of filaments across the brush head.
2. A toothbrush according to Claim 1, in which one pair of sides of each tuft cross-section are substantially perpendicular to the row.
3. A toothbrush according to Claim 2, in which the said pair of sides are convex, providing a cask shape to the cross-section.
4. A toothbrush according to any preceding claim in which the tufts are separated from adjacent tufts in the same row by a gap of less than 0.4 mm.
5. A toothbrush according to any preceding claim, wherein the filaments in each tuft are generally rectangular in cross-section with one pair of sides generally parallel to the row.
6. A toothbrush according to Claim 5, in which the cross-section of the filaments is such that the sides parallel to the row are shorter than those perpendicular to the row.
7. A toothbrush according to any preceding claim, in which the filaments are of equal height.

FIG. 1





F I G. 2



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## EUROPEAN SEARCH REPORT

Application Number  
EP 98 30 5981

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
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A	* page 2, right-hand column, line 3 - line 50; figures 1-3 *	3-6,8	
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A	* page 2, line 1 - page 3, line 27; figure 1 *	5,6,8	
A	DE 40 10 671 A (VUKOSAVLJEVIC) 23 August 1990	1	
	* column 1, line 44 - column 2, line 5; figures 1-5 *		
A	DE 94 21 388 U (VALENTIN) 5 October 1995	1	
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<p>The present search report has been drawn up for all claims</p>			
Place of search	Date of completion of the search	Examiner	
THE HAGUE	19 November 1998	RIVERO C.G.	
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background C : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons R : member of the same patent family, corresponding document	

**ANNEX TO THE EUROPEAN SEARCH REPORT  
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EP 98 30 5981

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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